

## CLAIMS

- 1     1.     A method for updating a qtree stored in a coalesced persistent consistency point  
2     image (PCPI) of one or more qtrees, the method comprising the steps of:  
3         transitioning from a stable state to an unstable update state as an update procedure  
4     commences;  
5         transitioning from the unstable update state to a done state in response to the up-  
6     date procedure succeeding;  
7         transitioning from the unstable update state to an unstable rollback state in re-  
8     sponse to the update procedure not succeeding, wherein a rollback procedure is per-  
9     formed to the qtree in the unstable rollback state and wherein the qtree transitions to the  
10    done state in response to the rollback procedure succeeding;  
11        performing a two step jump ahead procedure from the done state to the stable  
12    state wherein a new coalesced base PCPI is exported comprising the qtree; and  
13        whereby only a fixed number of PCPIs are consumed in updating the coalesced  
14    PCPI.
- 1     2.     The method of claim 1 wherein a qtree in the stable state corresponds to a source  
2     at a point in time.
- 1     3.     The method of claim 1 wherein a qtree in the unstable update state is being modi-  
2     fied during an update procedure wherein changes are transferred from a source to a desti-  
3     nation comprising the qtree.
- 1     4.     The method of claim 1 wherein the done state signifies that a source has com-  
2     pleted sending data during an update and the qtree is committed to completing the update.
- 1     5.     The method of claim 1 wherein the fixed number of PCPIs comprises four PCPIs.

1     6.     The method of claim 1 wherein the fixed number of PCPIs comprises a coalesced  
2     base PCPI, a coalesced rollback PCPI, an intermediate jump-ahead PCPI and the new  
3     coalesced base PCPI.

1     7.     The method of claim 1 further comprising the step of transitioning to an unstable  
2     uncoalesced state in response to a rollback procedure not succeeding.

1     8.     A system for updating a qtree stored in a coalesced persistent consistency point  
2     image (PCPI) of one or more qtrees, the system comprising:  
3             a management agent adapted to perform an update procedure from a source to the  
4     qtree, wherein the qtree transitions from a stable state to an unstable update state as the  
5     update procedure commences; and  
6             wherein the management agent is further adapted to transition the qtree from the  
7     unstable update state to a done state in response to the update procedure succeeding.

1     9.     The system of claim 8 wherein the management agent is further adapted to per-  
2     form a two step jump ahead procedure to transition the qtree from the done state to the  
3     stable state wherein a new coalesced PCPI is exported; and  
4             wherein the two step jump ahead procedure transitions all qtrees in the coalesced  
5     PCPI to the stable state.

1     10.    A system for updating a qtree stored in a coalesced persistent consistency point  
2     image (PCPI) of one or more qtrees, the system comprising:  
3             means for transitioning from a stable state to an unstable update state as an update  
4     procedure commences;  
5             means for transitioning from the unstable update state to a done state in response  
6     to the update procedure succeeding;  
7             means for transitioning from the unstable update state to an unstable rollback state  
8     in response to the update procedure not succeeding, wherein a rollback procedure is per-

9     formed to the qtree in the unstable rollback state and wherein the qtree transitions to the  
10    done state in response to the rollback procedure succeeding;  
11            means for performing a two step jump ahead procedure from the done state to the  
12    stable state wherein a new coalesced PCPI is exported comprising the qtree; and  
13            whereby only a fixed number of PCPIs are consumed in updating the coalesced  
14    PCPI.

1    11.    A method for tracking a set of organizational structures that are updated on a des-  
2    tination system replica by changes transmitted from a source system comprising the steps  
3    of:

4            establishing a stable state in which each of the organizational structures in the set  
5    is consistent in the replica and free of update activity;

6            when updating the organizational structures with the changes, moving the organ-  
7    izational structures into either a done state wherein the changes have been made to all of  
8    the organizational structures in the set or an unstable state wherein the changes have not  
9    been made successfully to at least one of the organizational structures;

10          when at least one of the organizational structures is in the unstable state, attempt-  
11    ing a rollback to an earlier version of the organizational structures;

12          if the rollback is successful, taking a single persistent consistency point image  
13    (PCPI) of the set organizational structures and if the rollback is unsuccessful, attempting  
14    a rollback to an earlier version of the at least one of the organizational structures sepa-  
15    rately and, if the rollback of the at least one of the organizational structures is successful,  
16    then taking a PCPI all of the set of organizational structures including the rollback ver-  
17    sion of the at least one of the organizational structures; and

18          from the PCPI, returning the set for organizational structures to the stable state.

1    12.    The method as set forth in claim 11 wherein the step of attempting the rollback  
2    includes periodically repeating the rollback attempt until all organizational structures are  
3    returned to an earlier version from which the PCPI can be taken.

- 1    13.    The method of claim 11 wherein the organization structures comprises qtrees.
- 1    14.    The method of claim 11 wherein a fixed number of PCPIs are consumed.
- 1    15.    The method of claim 14 wherein the fixed number of PCPIs comprises a coa-  
2    lesced base PCPI, a coalesced rollback PCPI, an intermediate jump-ahead PCPI and a  
3    new coalesced base PCPI.
- 1    16.    The method of claim 15 wherein the coalesced rollback PCPI is only generated if  
2    a rollback is attempted on one or more of the organizational structures.